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U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Southwest Fisheries Science Center

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ABSTRACT

The Hawaiian monk seal, *Monachus schauinslandi*, was studied on Laysan Island, Northwestern Hawaiian Islands, from 4 May to 4 August 1986. Beach counts ($N = 20$) ranged from 102 to 147 seals ($\bar{x} = 122.2$) excluding pups and from 122 to 174 ($\bar{x} = 144.4$) including pups. Twenty-three of the 30 pups tagged in 1985 were resighted. Six seals moved to or from Laysan Island. A total of 110 seals were tagged: 32 of the 34 pups born in 1986 were tagged, a yearling that had lost a tag was retagged, 73 males (adult, subadult, and juvenile) were newly tagged, and 4 males were retagged. Adult male aggression appeared to be involved in five of the six known deaths and in 15 of the 27 known nonfatal injuries; the death of a weaned (male) pup is described in detail. Four necropsies were performed, and the entire skeleton of one adult female was transported to Honolulu for the Bishop Museum. One seal was entangled in debris, and 137 pieces of marine debris were inventoried and sampled.

INTRODUCTION

Extensive research to monitor and aid the recovery of the endangered Hawaiian monk seal, *Monachus schauinslandi*, has been conducted yearly since 1977 at Laysan Island (lat. 25°42'N, long. 171°44'W), Northwestern Hawaiian Islands. Beginning in 1981, this monitoring has been conducted by the Honolulu Laboratory of the Southwest Fisheries Science Center, National Marine Fisheries Service (NMFS), NOAA. This report presents the 1986 findings; it is not intended to present and review other monk seal research. Findings from Laysan Island for other years since 1977 are reported in Johnson and Johnson (1978, 1981a, 1981b, 1984); Alcorn (1984); Johanos et al. (1987); Johanos and Austin (1988); Alcorn and Buelna (1989); Becker et al. (1989); and Johanos et al. (1990).

METHODS

A 3-month-long seal research camp was established on Laysan Island from 4 May to 4 August 1986. Objectives were to (1) census seals, (2) document reproduction and tag all weaned pups, (3) tag male seals, (4) document injuries and deaths, (5) collect scats, spews, and necropsy samples, (6) document entanglements, and inventory and sample debris capable of entangling seals.

We were both present on Laysan Island during the entire research period, along with U.S. Fish and Wildlife Service (USFWS) personnel conducting bird research, and brief visits were made by a film crew and others (Appendix A). The 7-mile perimeter of Laysan Island was divided into the same 20 sectors used since 1982 to define seal locations during data collection (Fig. 1).

Individual seals were recognized by bleach markings, tags, natural markings, and scars. Bleach was not applied on Laysan Island seals in 1986, but some seals still bore bleach marks from 1985. Two (tan) plastic Temple Tags³ were put on each weaned pup, one tag in each hind flipper. A new tag was also put on a yearling which had lost one tag. Seals were restrained when they were tagged with Temple Tags; for a description of the pup tagging procedure, see Gilmartin et al. (1986). Metal (Monel) tags were applied to one or both hind flippers of adult and subadult males and one juvenile male; tagging priority was given to adults with temporary (1985 postmolt) bleach marks, so identity would not be lost with the 1986 molt. Seals were not restrained for tagging with Monel tags; for a description of this tagging procedure see Alcorn and Buelna (1989). We were not able to ascertain at the time of tagging whether the metal tag was on securely because the seals were not restrained. We, therefore, attempted to resight newly tagged seals and

³Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

apply a second tag if the first one trailed the web by more than one-half the tag length or if the tag did not appear to have locked.

Censuses were conducted every 2 to 7 days; the goal was to conduct 20 censuses within the 3-month research period. Censusing commenced at 1300 hours (Hawaii standard time) as we simultaneously departed camp in opposite directions and proceeded around the island perimeter until we met. Consult Stone (1984) for a description of age (size) classification, Johanos et al. (1987) for the census protocol, and Forsyth et al. (1988) for a copy of the preprinted census form and 1986 coding instructions. We restricted our movements and did not tag seals on census days prior to the census to minimize potential disturbance that could affect seal haul-out patterns.

In addition to formal censuses, we made informal patrols along portions of the island perimeter. Time, direction, area covered, purpose, and the number of persons conducting the patrol varied; however, we attempted to circuit the entire island at least every other day, either on a census or patrol. During patrols, we tagged seals, photographed and sketched seal physical characteristics for identification, collected spews, and inventoried and sampled entanglement debris. We also recorded tag resightings, births, injuries and deaths, using the same forms used during censuses.

RESULTS AND DISCUSSION

Censuses

We conducted 20 censuses from 9 May through 2 August 1986 (Appendix B). Counts ranged from 102 to 147 seals (\bar{x} = 122.2) excluding pups, and from 122 to 174 (\bar{x} = 144.4) including pups. Average number of seals present during the 1986 censuses was considerably higher than in the previous year; during a comparable time period (11 May through 3 August 1985; n = 30 censuses), the average was 98.9 excluding pups and 118.1 including pups (Becker et al. 1989). Twenty-three (13 males and 10 females) of the 30 pups (16 males and 14 females) tagged in 1985 were seen in 1986 on Laysan Island.

Interisland Movement

Six seals (two males and four females) moved to or from Laysan Island in 1986: one made a round trip to French Frigate Shoals; one moved from Laysan Island to French Frigate Shoals; one moved from Lisianski Island to Laysan Island; and three moved from Laysan Island to Lisianski Island (Table 1).

Reproduction

Thirty-four pups were born: 17 females, 16 males, and 1 of unknown sex (Table 2). This is slightly higher than the 32 (Johanos and Austin 1988) born in 1985. No females were obviously preparturient when data collection ended in August.

Tagging

A total of 110 seals were tagged during 1986. Thirty-two of the 1986 pups were tagged with Temple Tags after weaning, one was still nursing when research ended, and one newborn pup was found dead. In addition, a juvenile (TT29) that had lost one tag received a new Temple Tag. Seventy-three males (adult, subadult, and juvenile) were newly tagged with metal tags, and four adult males that had lost metal tags applied during 1985 received new tags (Appendix C). Despite seals not being restrained when metal tags were applied, at least 56 of the 77 seals had tags which extended <10 mm beyond the hind flipper edge.

Deaths and Injuries

There were six known deaths: five appeared to be related to injuries inflicted by one or more adult males and the cause of the remaining death was unknown (Table 3). We performed only four necropsies (Appendix D), because two carcasses were not recovered: one was consumed by sharks, and the decomposing carcass of the newborn pup seen during the initial circuit of the island could not be relocated following a storm. A pancreatic cyst, a condition not previously reported in Hawaiian monk seals, was found in adult female T23F. The carcass of this female was flensed, buried in the sand, and, at the end of the research camp, taken to Honolulu where the skeleton was permanently loaned to the Bishop Museum in 1988.

We documented 27 nonfatal injuries: 15 appeared to have been inflicted by adult male monk seals, 3 by cookie cutter sharks, *Isistius brasiliensis*, 2 by larger sharks, and 7 by unknown causes (Table 4).

Adult male aggression appeared to be related to 84% of the observed deaths and 55.6% of the nonfatal injuries. We witnessed the incident leading to the death of a weaned male pup (TL36) caused by an adult male. In this incident, detailed in Appendixes E and F, the pup appeared weakened from earlier adult male-inflicted injuries; immediate cause of death was probably drowning because the pup had breathing difficulties and was frequently submerged when the adult male seal T475 mounted it. The aggressive behavior of the seal T475 did not appear to change after the pup died; seal T475 continued to bite and mount the pup and attempted to defend the carcass from another adult male. Seal T475 repeatedly pushed its nose into the pup's dorsal wound, a behavior repeated by the adult male T723 that subsequently displaced him at the carcass.

We also witnessed an adult female (T11N) receive dorsal scratches and punctures from up to six adult males during a "mobbing" attack in sector 18 on 18 June 1986 from 1313 to 1451 hours. "Mobbing" is described as an attempt by several males to mate with a single adult female or immature seal of either sex. The incident originated and ended on the beach, but at one time the female with associated males moved 37 m offshore.

Debris and Entanglement

A total of 137 items of debris capable of entangling seals were found and sampled. Analysis of debris type is ongoing and will be reported elsewhere.

A seal was entangled in one of the debris items. On 14 June, a subadult male with a thick rope looped around his neck and left foreflipper was seen resting on the damp sand (sector 8). The rope appeared to be tightly wrapped, but when removed (by DJA), it appeared that the seal probably could have extricated itself.

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Table 1.--Interisland movement of Hawaiian monk seals, to and from Laysan Island, 1986 (A = adult, S = subadult, and J = juvenile; M = male and F = female; FFS = French Frigate Shoals).

Perm. ID	Tags			Size and sex	Movement from		Movement to	
	Left	Right	Color		Location	Date last seen	Location	Date first seen
TT14	T14	T12	tan	SM	Laysan ^a	11/26/85	Lisianski ^b	5/31/86
G027	027	028	green	SF	Laysan ^a	7/7/85	Lisianski ^b	8/10/86
T25F	--	--	--	AF	Laysan ^a	7/28/85	Lisianski ^b	8/18/86
TT36	T35	T36	tan	SM	Laysan ^a	11/23/85	FFS ^c	9/2/86
Y156	--	--	--	AF	Laysan ^a	7/26/85	FFS ^d (East)	4/19/86
"	"	"	"	"	FFS ^d	5/28/86	Laysan	6/23/86
GK24	K24	K25	green	JF	Lisianski ^e	7/13/85	Laysan	5/10/86

^aBecker et al. 1989.

^bWestlake and Siepmann 1988.

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^eAlcorn et al. 1988.

Table 2.--Birth summary of Hawaiian monk seal pups on Laysan Island, 1986 (M = male, F = female, U = unknown sex, AG = axillary girth, and DSL = dorsal straight length).

ID No.	Sex	Birth		Weaning		Nursing period (days)	Measurements (cm)			Mother ID
		Date	Islet/ Sector	Date	Islet/ Sector		Date	AG	DSL	
TL00	F	--	--	<5/11	--	--	5/11	98.0	122.0	--
TL02	M	--	--	<5/11	--	--	--	--	--	--
TL04	F	--	--	<5/13	--	--	5/13	113.0	128.0	--
TL06	M	--	--	<5/13	--	--	5/13	92.0	124.0	--
TL08	M	--	--	<5/13	--	--	5/13	88.5	115.0	--
TL10	M	--	--	<5/13	--	--	5/13	100.0	122.0	--
TL12	F	--	--	<5/13	--	--	5/13	102.5	130.0	--
TL14	F	--	--	<5/13	--	--	--	--	--	--
TL16	F	--	--	<5/13	--	--	5/13	98.0	132.0	--
TL18	F	--	--	<5/13	--	--	5/13	97.0	129.0	--
TL20	F	--	--	5/13	4	--	5/13	112.0	131.0	005
TL22	F	--	--	5/13	3	--	5/13	105.0	132.0	T08F
TL24	M	--	--	5/14	3	--	5/14	104.0	125.0	006
TL26	F	--	--	<5/16	--	--	5/16	97.0	126.0	--
TL28	F	--	--	<5/19	--	--	--	--	--	--
TL30	F	--	--	<5/21	--	--	--	--	--	--
TL32	M	--	--	<5/21	--	--	--	--	--	--
TL36	M	--	--	5/17	18	--	5/24	96.0	121.0	T04F
TL34	F	--	--	--	--	--	--	--	--	--
TL38	F	--	--	5/25-7	10	--	5/31	105.0	121.0	T06F
TL40	M	--	--	5/25-7	12	--	5/31	97.0	118.0	TY49
TL42	F	--	--	5/24	2	--	5/28	112.0	113.0	T11N
TL45	M	--	--	6/04	20	--	6/05	115.0	131.0	T17F
TL46	M	--	--	6/13	2	--	6/14	106.0	132.0	T03F
TL48	M	--	--	6/15	20	--	6/15	106.0	128.0	T11F
TL50	M	--	--	6/12	18	--	6/16	106.0	125.0	T12F
TL52	M	--	--	6/15-6	11	--	6/18	110.0	129.0	T14F
TL54	M	--	--	6/12	19	--	6/19	102.0	128.0	T21F
TL56	F	5/06	3	6/20	3	45	6/21	111.0	137.0	T302
TL58	M	5/09	20	6/27	20	47-48	6/25-6	98.0	123.0	T22F
TL60	F	5/15	4	6/28	5	--	7/01	100.0	131.0	T24F

Table 2.--Continued.

ID No.	Sex	Birth		Weaning		Nursing period (days)	Measurements (cm)			Mother ID
		Date	Islet/ Sector	Date	Islet/ Sector		Date	AG	DSL	
TL62	F	5/31	6	7/11	6	--	7/14	114.0	134.0	T27F
--	M	7/13	18	--	--	--	--	--	--	T39F
Dead	U	>4/14	--	--	--	--	--	--	--	--

Table 3.--1986 Hawaiian monk seal deaths on Laysan Island (A = adult, J = juvenile, W = weaned pup, N = nursing pup; F = female, M = male, U = sex unknown; cause of death, K = known, P = probable).

Necropsy number	Date of death	Size	Sex	ID	Cause of death
--	<5/6	N	U	--	Unknown
01LA86	5/6 ^a	A	F	T23F	Adult male (dorsal wounds) (P)
--	6/2	W	M	TL36	Adult male (dorsal punctures, dorsal swelling; drowning?) (K)
02LA86	6/5	J	M	TK31	Adult male (dorsal wounds, punctures, scratches) (P)
03LA86	<5/4	A	F ^b	--	Adult male (dorsal wound) (P)
04LA86	7/8	W	M	TL02	Adult male (dorsal punctures and swelling) (P)

^aThis is the necropsy date; date of death is unknown but is thought to be 5/5 or 5/6.

^bCarcass examined carefully and baculum not found; unable to determine sex from reproductive organs because of deterioration.

Table 4.--Injuries of Hawaiian monk seals on Laysan Island, 1986 (A = adult, S = subadult, J = juvenile, W = weaned pup, M = male, and F = female).

Injury No.	Date	Size	Sex	ID No.	Description of injury				
					Type ^a	Location ^b	Depth ^c layer	Dimension (cm) (1 x w or diam)	Probable cause
001	5/07	A	M	T460	CIR	MID/D	--	--	CC SHARK ^d
002	5/13	A	M	TH07	ABC	L/ANT	--	5.0 X 25.0	UNKNOWN
003	5/13	S	F	--	AMP	RHF	--	--	UNKNOWN
004	5/14	J	M	TK05	LAC	D	SURF	--	ADULT MALE
005	5/14	A	F	--	LAC	D/L LAT	SURF	--	ADULT MALE
006	5/16	A	F	T16F	LAC	D	SURF	--	ADULT MALE
007	5/16	J	F	TT02	CIR	V	BLUB	5.0 (DIAM)	CC SHARK ^d
008	5/20	A	F	--	PUN	MID/D	--	2.5 (DIAM)	ADULT MALE
009	5/21	A	M	T711	OTH ^e	ANT	--	--	UNKNOWN
010	5/29	W	F	TL38	LAC	D/V	SURF	4.0 (DIAM)	ADULT MALE
011	5/31	A	F	T51F	LAC	D	SURF	--	ADULT MALE ^f
012	6/05	J	F	TT58	LAC	ANT/V	SURF	17-22 (LENGTH)	UNKNOWN
013	6/07	A	F	T37F	GAP	D	BLUB	5.0 (LENGTH)	ADULT MALE ^g
014	6/07	A	F	--	PUN	L/ANT	SKIN	13.0 (DIAM)	UNKNOWN
015	6/07	J	M	TK27	PUN	D	SKIN	1.25 (DIAM)	ADULT MALE
016	6/07	W	F	TL18	PUN	ANT/D	SKIN	--	ADULT MALE
017	6/11	A	M	T719	LAC	RHF	MUSC	23.0 (LENGTH)	SHARK
018	6/12	A	F	T26F	PUN/LAC	D	MUSC	50%	ADULT MALE
019	6/16	A	M	T726	LAC	MID/D	BLUB	20.0 (LENGTH)	UNKNOWN
020	6/17	W	F	TL6N	ABC	POST/D	--	15.0 (DIAM)	ADULT MALE
021	6/18	A	F	T11N	PUN/LAC	D	--	--	ADULT MALE
022	6/19	W	F	TL22	LAC	D	SURF	--	ADULT MALE
023	6/22	A	M	T760	GAP	R/ANT	BLUB	16.5 (LENGTH)	SHARK
024	6/30	A	M	T07M	LAC	D	--	--	UNKNOWN
025	7/10	J	F	TK51	GAP/PUN	D	BLUB	30.5 x 10.0	ADULT MALE
026	7/14	S	M	--	CIR	V	SKIN	--	CC SHARK ^d
027	7/19	J	F	GK25	LAC	L/ANT	BLUB	13.0 (LENGTH)	ADULT MALE

APPENDIXES

Appendix A.--Itinerary for the 1986 Laysan Island field camp of the
National Marine Fisheries Service (NMFS).

Date	Event
4/29	D. Alcorn and R. Westlake depart Honolulu on board the NOAA ship <i>Townsend Cromwell</i> , bypass Laysan Island, and arrive at Lisianski Island on 3 May. Conduct seal census, tag weaned pups, and depart same day for Laysan Island.
5/4	<i>Townsend Cromwell</i> arrives at Laysan Island. Alcorn and Westlake disembark with E. Bean, A. Marshall, and J. Simasko of the U.S. Fish and Wildlife Service (USFWS) and P. Atkins, J. Bell, and M. DeGruy, of Moana Film Productions. Establish camp on the west side. The two USFWS researchers already present, K. McDermond and M. Morin, begin to move their camp from the northeast to the west side. The <i>Townsend Cromwell</i> departs.
5/16	The <i>Goode Wind</i> arrives, embarks Atkins, Bell, DeGruy, and Simasko, and departs.
5/26	The <i>Feresia</i> arrives and disembarks T. Gerrodette (NMFS), D. Hu, and T. Ohashi (USFWS).
5/29	The <i>Feresia</i> embarks Gerrodette, Hu, McDermond, and Ohashi and departs. A five-person research camp remains on Laysan Island (Alcorn, Westlake, Bean, Marshall, and Morin). Naturalists from the <i>Ashley St. Mary</i> spend half a day on the island with USFWS.
6/19-22	The <i>Feresia</i> arrives, anchors offshore, and delivers supplies.
7/29	The <i>Townsend Cromwell</i> arrives, disembarks P. Siepmann (NMFS), and conducts research offshore.
8/2-3	Disband camp and load supplies on the <i>Townsend Cromwell</i> .
8/4	All personnel on Laysan Island depart on board the <i>Townsend Cromwell</i> .

Appendix B.--Hawaiian monk seals counts at Laysan Island, 1986
(M = male, F = female, and U = unknown).

Date	Adult			Sub-adult			Juvenile			Pup			Total		
	M	F	U	M	F	U	M	F	U	M	F	U	Nonpup	Pup	Combined
05/09	31	20	16	10	10	18	17	13	4	4	4	14	139	22	161
05/16	37	25	3	8	10	14	14	16	1	11	12	5	128	28	156
05/19	43	20	10	19	15	11	16	11	2	10	9	8	147	27	174
05/21	32	21	5	13	12	11	19	14	2	10	7	5	129	22	151
05/24	36	24	7	10	13	10	13	5	2	9	9	4	120	22	142
05/27	28	25	9	15	17	6	9	12	2	10	15	0	123	25	148
05/30	32	17	12	13	10	11	18	15	1	10	11	3	129	24	153
06/03	39	27	6	9	14	8	17	10	2	9	9	5	132	23	155
06/07	30	24	9	15	16	6	9	6	3	8	7	4	118	19	137
06/11	39	22	2	14	14	4	12	7	2	10	9	0	116	19	135
06/14	27	19	9	11	13	7	19	11	2	11	14	3	118	28	146
06/18	34	25	9	14	13	5	12	15	3	10	13	0	130	23	153
06/22	40	15	7	13	9	13	10	11	5	11	8	1	123	20	143
06/26	39	16	4	15	13	9	13	15	1	9	13	1	125	23	148
06/30	30	20	2	13	9	6	15	16	4	8	10	0	115	18	133
07/07	30	22	2	10	9	7	13	11	3	7	8	0	107	15	122
07/14	35	13	4	9	9	5	15	11	1	12	11	0	102	23	125
07/21	30	18	0	10	8	8	17	17	4	8	12	0	112	20	132
07/28	33	17	2	14	10	3	20	18	4	11	10	0	121	21	142
08/02	33	14	7	9	8	10	17	8	3	8	13	2	109	23	132
Mean													122.2		144.4
Standard Deviation													10.9		12.8

Appendix C.--Hawaiian monk seal males (non-pup) tagged with metal tags on Laysan Island, 1986 (A = adult, S = subadult, or J = juvenile).

Tag no. ^a		Identification		Size	Date ^b
Left	Right	ID no.	1985 bleach no. (postmolt)		
X102		T438	438	A	5/10
X103		T448	448	A	5/21
	X105	TY07	450	A	5/23
X156	X106	TY75	Y75	A	5/23
X107		T460	460	A	5/28
	X108	TH05	H05	A	5/28
	X109	T768	768	A	5/29
	X110	TP87	P87	S	5/29
X111		T725	725	A	5/29
X112		T424	424	A	6/3
X114		T732	732	A	6/5
X116		GS33	S33	A	6/7
	X117	T434	434	A	6/4
X118		TP09	P09	S	6/4
X119		T717	717	A	6/5
	X120	T770	770	A	6/9
	X122	T729	729	A	6/13
X123		T364	748	A	6/16
	X124	T715	715	A	6/16
X125		T462	462	A	6/17
	X126	T758	758	S	6/9
	X127	TY55	Y55	A	6/12
	X128	TY74	700	A	6/13
	X129	T340	340	S	6/13
	X131	T718	718	A	6/22
X132		TP41	P41	A	6/28
	X133	T803	803	A	6/28
	X134	T412	412	A	6/13
X144	X135	T723	723	A	6/15
	X136	T778	778	A	6/16
	X137	T415	415	A	6/16
X138		T734	734	A	6/16
X139		T435	435	A	6/17
X140		TH07	H07	A	6/22
	X142	T757	757	S	6/22
X143		T716	716	A	6/20
	X145	T349	349	A	6/23
	X146	T764	764	A	6/17
X147		T395	707, 704	A	6/23
X148		T720	720	A	6/24
X149		T741	741	A	6/24

Appendix C.--Continued.

Tag no. ^a		Identification		Size	Date ^b
Left	Right	ID no.	1985 bleach no. (postmolt)		
X150		T421	421	A	6/24
X151		T746	746	A	6/28
	X153	T426	426	A	7/4
X154		T763	763	A	7/7
X155		TY41	Y41	A	7/9
X158	X157	T808	808	A	6/27
X160		T708	708	A	6/28
X161		T766	766	S	7/1
	X162	T743	743	A	7/4
	X163	T726	726	A	7/4
	X164	T759	759	A	7/7
	X165	T429	429	A	7/10
	X166	T339	705	A	7/9
	X167	TP49	P49	S	7/11
X168		TY60	Y60	A	7/12
	X169	T701	701	A	7/14
X170		T731	731	A	7/15
	X171	T735	735	S	7/10
X172		T709	709	A	7/10
X173		TY88	Y88	A	7/11
X174		T445	445	A	7/14
	X175	T408	408	A	7/16
	X177	T080	417	A	7/18
	X178	T750	750	A	7/18
	X179	T749	749	S	7/22
	X180	T745	745	A	7/25
X181		T755	755	A	7/17
	X182	--	XXX	A	7/18
	X183	T762	762	A	7/28
X184		T442	442	A	7/28
X185		T765	765	A	7/28
X186		--	744	A	8/2
X189		T710	710	A	7/25
	X190	TY33	Y35	S	7/28
X191		T75M	--	J	8/1
X192		T711	711	A	8/1

^aThe following tags were used in 1986, but are not on seals: X101, X115, and X200 were used on cloth to test the tagging pliers; X113, X121, X130, X141, X152, X159, and X176 fell off the hind flippers after being applied.

^bThe date when the first tag was applied in 1986 is given when more than one tag was applied.

Appendix D.--Hawaiian monk seal necropsy reports, Laysan Island, 1986.

NECROPSY NO.: 01LA86
 DATE OF DEATH: 6 May
 DATE OF NECROPSY: 6 May
 SEX: Female
 SIZE CLASS: Adult
 IDENTIFICATION NO.: T23F

CIRCUMSTANCES OF DEATH: Found dead, floating on back in surf (sector 2) guarded by an adult male (T308). Carcass fresh; death within past 5 hours. Found on our first circuit of Laysan Island.

EXTERNAL DESCRIPTION: Numerous, fresh, gaping wounds on the middorsal. Blood coming from the right nare; yellow fluid from left. Rigor mortis evident. No milk exuded from teats. Thin appearance.

Measurements: Standard length (ventral side up) = 205.0 cm
 Axillary girth (no bloat) = 106.0 cm
 Blubber thickness (base of sternum) = 2.3 cm

INTERNAL DESCRIPTION: No gross abnormalities noted for: lymph nodes, abdominal cavity, adrenals, female reproductive tract (and no blockage of fallopian tubes), gall bladder, heart, respiratory tract, kidney, or liver. Thymus not found.

The following was noted: stomach (omentum) red, thin with many holes; many roundworms (some still alive); and a few small ulcerated areas with worms attached. Stomach contents consisted of lobster, cephalopod beaks, and yellow fluid. Pancreatic cyst (7 x 6 x 4 cm) filled with white fluid.

<i>Measurements:</i>	<i>Organs</i>	<i>Size</i>	<i>Weight</i>
	thyroid (right)	--	9.5 g
	adrenal (left)	60 x 20 x 11 mm	17.0 g
	adrenal (right)	57 x 16 x 9 mm	12.0 g
	ovary (left)	24 x 16 x 4 mm	4.0 g
	ovary (right)	24 x 15 x 4 mm	4.0 g
	uterus	12 cm	--
	vagina	19 cm	--
	kidney (left)	25 x 9 x 4 cm	--
	kidney (right)	25 x 9 x 5 cm	--
	spleen	29 x 10 x 1.2 cm	270.0 g

SAMPLES COLLECTED: Preserved in formalin--thyroids, adrenals, lymph node (retroperitoneal), ovaries, uterus, vagina, kidneys, spleen, pancreas, stomach omentum and associated parasites, mesenteric nodes, liver, gall bladder, heart muscle, and lungs. Frozen for toxicology--blubber, kidney, and liver. Skull and entire skeleton saved.

Appendix D.--Continued.

NECROPSY NO.: 02LA86
 DATE OF DEATH: 5 June
 DATE OF NECROPSY: 6 June
 SEX: Male
 SIZE CLASS: Juvenile (1 year old)
 IDENTIFICATION NO.: TK31

CIRCUMSTANCES OF DEATH: Found dead in surf (sector 4) with muzzle pushed into sand; adult male T726 against and partly on top of carcass. Death within 24 hours of the necropsy.

EXTERNAL DESCRIPTION: Numerous dorsal and lateral scratches into the skin; a few pink dorsal punctures. The largest puncture, 16 x 10 mm, extended into the muscle layer. Nares bloody. Rigor. Green on pelage and no sign of molt. A small, thin seal, but not unusually so for a yearling. The Temple Tag had ripped from the left hind flipper; both tags were on when the seal was last seen alive on 3 June. We removed the remaining tag and noted there was no irritation from the tag; the hole was slightly larger than the tag insertion diameter, and the edges of the hole were healed.

Measurements: Standard length (ventral side up) = 141.5 cm
 Axillary girth (no bloat) = 86.0 cm
 Blubber thickness (base of sternum) = 2.5 cm

INTERNAL DESCRIPTION: Ribs intact; no abdominal fluids nor blood. Organs not discolored--no smell. Stomach had a few small ulcers, none perforating the wall; large numbers of both roundworms and tapeworms in stomach (some still alive); small amount of fluid, fish bones, cephalopod beaks and one lens; heavy tapeworm load in entire intestinal tract.

<i>Measurements:</i>	<i>Organs</i>	<i>Size</i>	<i>Weight</i>
	thyroid (left)	29 x 11 x 4 mm	14 g
	thyroid (right)	31 x 11 x 4 mm	12 g
	lymph node (scap.)	4 x 2 x 0.8 cm	11 g
	adrenal (left)	4.5 x 1.2 x 0.7 cm	9 g
	adrenal (right)	5.9 x 1.7 x 0.9 cm	10 g
	testis (left)	3.7 x 2.4 x 1.6 cm	8 g
	testis (right)	3.5 x 1.7 x 1.9 cm	8 g
	kidney (left)	16.5 x 6.5 x 3.0 cm	--
	kidney (right)	--	--
	spleen	27 x 5.5 x .3 cm	93 g
	thymus	--	22 g

SAMPLES COLLECTED: Preserved in formalin--thyroids, lymph nodes (left and right scapular), adrenalis, testes and epididymis, kidney, spleen, pancreas and associated lymph node, stomach/intestines and associated parasites, liver, gall bladder, thymus, heart (entire), lung, and brain.

Frozen for toxicology--blubber and kidneys. Skull saved.

Appendix D.--Continued.

NECROPSY NO.: 031A86
DATE OF DEATH: <4 May (mid-April)
DATE OF NECROPSY: 27 June
SEX: Female ?
SIZE CLASS: Adult
IDENTIFICATION NO.: --

CIRCUMSTANCES OF DEATH: U.S. Fish and Wildlife Service personnel (Ken McDermond) found seal dead prior to 4 May, the first day of the National Marine Fisheries Service's 1986 field camp at Laysan Island. He had seen it alive with massive dorsal wounds a few days prior to its death; posterior half of back laid open with gaping wound into muscle.

EXTERNAL DESCRIPTION: Seal dead approximately 2-3 weeks on 4 May; face down in sand (sector 4), .5-1.5 m feet from high tide line; rotten, bloated, pelage slipping, maggots. Open dorsal wound about 77 cm long. Teeth worn, some missing. Hind flippers rotting; no tags found on them or in sand.

Measurements: Standard length (dorsal side up) = 208 cm^a

INTERNAL DESCRIPTION: Organs still discernable anterior of seal but not posterior. No baculum found.

SAMPLES COLLECTED: Rectal fecal matter. Skull and right pelvis.

^aLength measurement should be considered an estimate because of deteriorated state of the carcass. This appeared to be an old, large seal.

Appendix D.--Continued.

NECROPSY NO: 04LA86
DATE OF DEATH: 8 July
DATE OF NECROPSY: 8 July
SEX: Male
SIZE CLASS: Weaned pup
IDENTIFICATION NO.: TL02

CIRCUMSTANCES OF DEATH: Weaned pup found dead on dry sand (sector 2); last seen alive the night before, 1732 hours.

EXTERNAL DESCRIPTION: Dorsal scratches and punctures, slight posterior-dorsal swelling. No injuries on ventrum. Eyes clear, nares clean--no blood, mucous, or mites.

Measurements: Standard length (ventral side up) = 123.0 cm
Axillary girth (no bloat) = 86.0 cm
Blubber thickness (base of sternum) = 2.7 cm

INTERNAL DESCRIPTION: Intestines not gaseous; color of organs normal. No parasites nor ulcers in stomach; a few tiny tapeworms in intestines. Teeth well developed. Pup in "fatted" condition throughout, including heart. Skull intact.

SAMPLES COLLECTED: *Preserved in formalin*--lymph node (scapular), left adrenal, testes and epididymis, kidneys, pancreas, stomach and contents, intestinal parasites, mesenteric node, liver, gall bladder, thymus, heart (entire), and lung. No samples frozen for toxicology. Skull saved.

Appendix E.--Overview of the death of weaned pup caused by an adult male, Laysan Island 1986.

Date	Event
5/17	Male pup TL36 weaned (from T04F) in sector 18.
5/21	Numerous superficial scratches on pup's back; adult male TY75 attended pup.
5/24	Pup was tagged and measured; size small (axillary girth 96.0 cm, standard length 121.0 cm). Pup active and appeared health except for the minor scratches.
5/28	New dorsal injuries: deeper, more extensive rake marks and associated swelling.
5/31	Pup lethargic: breathing labored and frequent.
6/1	Pup still lethargic and breathing labored. Extensive dorsal swelling with small pink area in center.
6/2	At 1208 hours, the pup was swimming alone inside the reef in sector 18 when adult male (TY75) approached him, attempted to mount, and bit him on the back. By 1210, one-half the back was ripped open. The pup was still alive at 1248 when observations temporarily ceased but it appeared dead at 1300 when observations resumed. TY75 swam with the carcass until he was displaced by adult male T723 at 1332. T723 attended the carcass until one or more sharks consumed it at 1439. (See Appendix F for more details.)
6/4	Adult male T723 seen resting on shore; no shark injuries.

Appendix F.--Detailed observations of weaned pup's death on 2 June 1986.

Time	Observation
1202	D. Alcorn checks pup (TL36). Pup swimming alone, 30-55 m offshore, inside the fringing reef. Pup's condition similar to night before: large dorsal swelling with pink center; frequent breathing; head lifts above water every 6-30 seconds.
1208	Adult male (TY75) approaches pup, jousts, and rolls. Pup attempts to swim away. TY75 bites the pup's back and attempts to mount. Pup vocalizes and rolls. Adult bites, pulling the dorsal skin, and about one-half of the back rips open. Pup and adult drift outside the reef about 67 m offshore, over the deep drop-off frequented by tiger sharks.
1211	Pup hauls out on wave-washed reef and rests on belly. TY75 hauls out within 2 m of the pup.
1218	Wave washes pup off reef, and TY75 follows pup into the water. Both seals start moving towards shore. During the next 0.5 hour, TY75 repeatedly bites and mounts pup; pup rolls onto back, vocalizes. Between biting and mounting, TY75 rests against or within 2 m of pup; touches noses or places chin on pup's open dorsal wound, or presses nose deep into wound and closes eyes; follows pup as pup slowly swims away.
1248	Pup still alive when Alcorn ends observations and returns to camp to get spotting scope and R. Westlake. (Alcorn arrives at camp at 1254, and Westlake arrives at site and resumes observations at 1300; Alcorn arrives about 10 minutes later with additional gear.)
1300	Pup floats, appears lifeless when observations are resumed. TY75 defends the pup's carcass from an unknown adult male.
1310	TY75 and pup carcass drift within 75 feet of shore. TY75 noses, bites, and mounts carcass; vocalizes although no other seals in vicinity.
1329	An adult male (T723) approaches TY75. TY75 rapidly swims towards him; they joust near the carcass 2.5 minutes. TY75 is driven away, but for a few minutes remains within 15 m of T723 which is circling the carcass.
1333	T723 continues to closely circle the carcass; drifts north (into sector 19) about 18 m offshore.
1342	T723 mounts carcass for the first time, pushing it underwater.
1347	T723 pushes nose into dorsal wound of carcass. They drift into a channel, and the current pulls them seaward.
1402	Now 55 m offshore ; T723 nosing, mounting but is not seen to bite.

Appendix F.--Continued.

Time	Observation
1403	T723 becoming more "active," pushing the carcass in addition to mounting and circling.
1407	T723 mounts the carcass.
1408	T723 circles.
1411	T723 dives, then circles carcass at surface.
1417	Pushes nose into dorsal wound and continues to circle carcass.
1421	Shark hits carcass; fin, blood, and splashing but T723 remains next to carcass.
1429	Splashing. T723 appears to be mounting, but far offshore and difficult to see.
1438	Oil slick on water. T723 stays close to what remains of carcass.
1439	Much splashing. Many small shark fins, water red. T723 sticks head out of water. Entire back of a large shark (over 3.65 m total length) thrashes high out of water next to T723. No sign of shark, T723, nor carcass (but difficult to see at distance).
1442	Frigate birds diving at scene, but no sign of anything else.
1443	Nothing in area except slick on water. End observations.

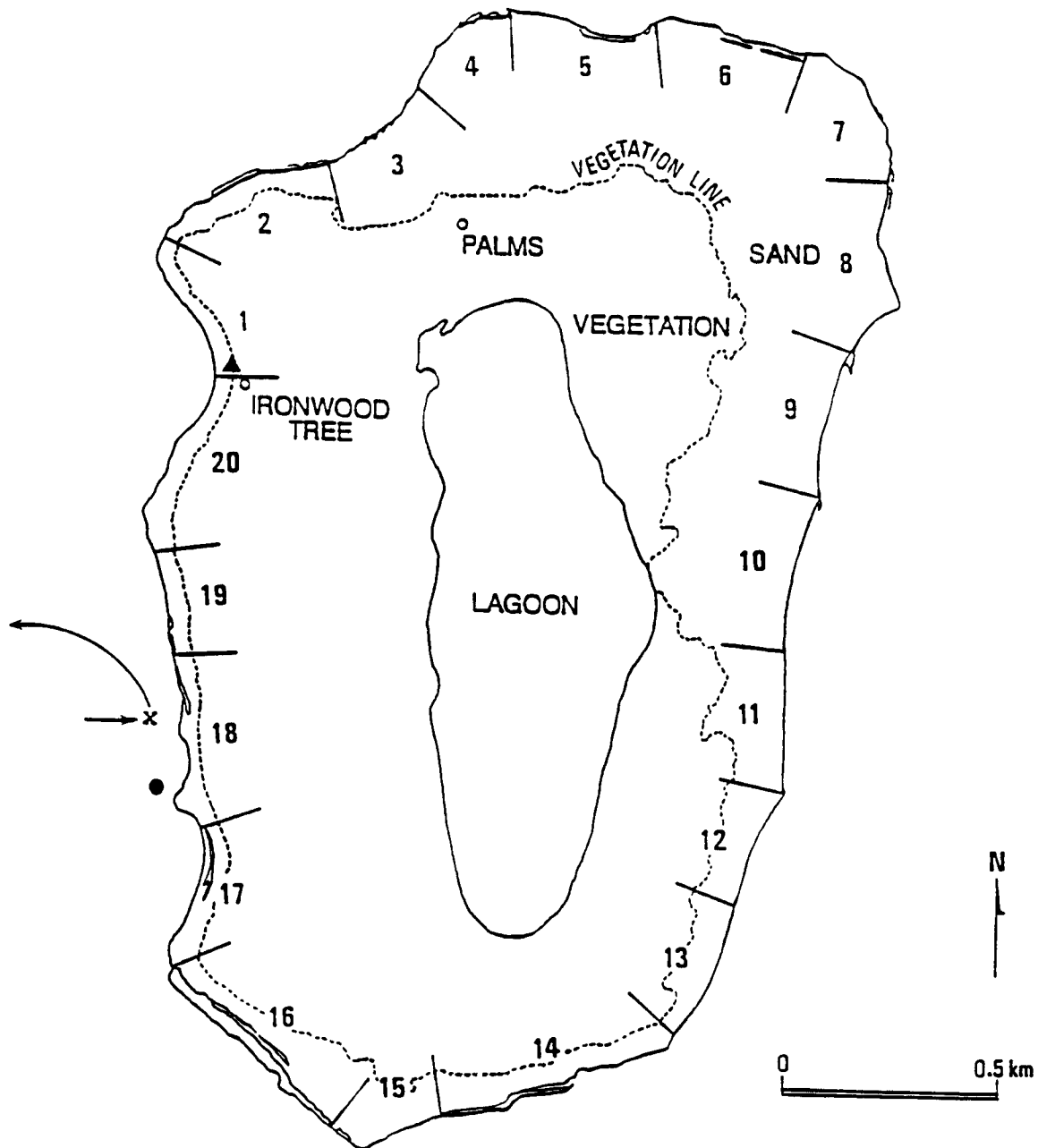


Figure 1.--Map of Laysan Island showing the location of the camp site (Δ), the 20 sectors, mobbing site (\bullet), and where an adult male killed a weaned pup (x).

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